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# THE JOURNAL
## OF
# THE ROYAL ASTRONOMICAL SOCIETY OF CANADA

DEVOTED TO THE ADVANCEMENT OF ASTRONOMY AND ALLIED SCIENCES

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## THE ROYAL ASTRONOMICAL SOCIETY OF CANADA

VOL. XXXIV, No. 9 NOVEMBER, 1940 WHOLE No. 298

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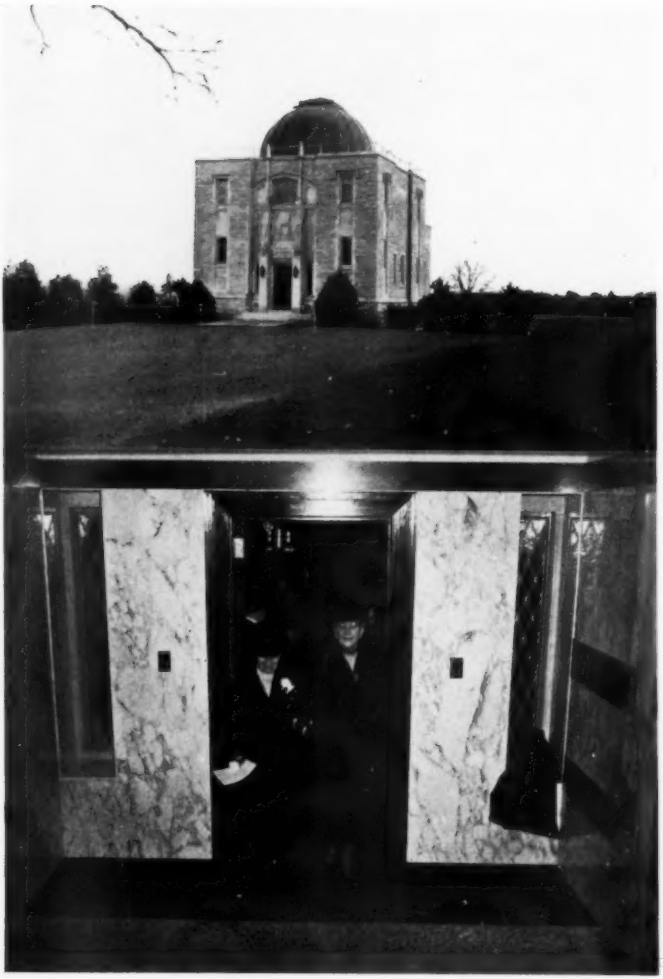
PLATE XIX

THE OPENING OF THE HUME CRONYN MEMORIAL OBSERVATORY, OCTOBER 25, 1940

*Above.* Dr. H. R. Kingston addressing the gathering. Those seated, left to right, are Mr. A. T. Little, Mrs. Hume Cronyn, Chancellor Cockshutt, President Fox, Professor Mitchell (eclipsed by Mr. R. H. Cronyn), Dr. C. A. Chant, Canon Warner.
*Below.* Professor S. A. Mitchell addressing the gathering.

*Journal of the Royal Astronomical Society of Canada, 1940.*

PLATE XX



THE HUME CRONYN MEMORIAL OBSERVATORY

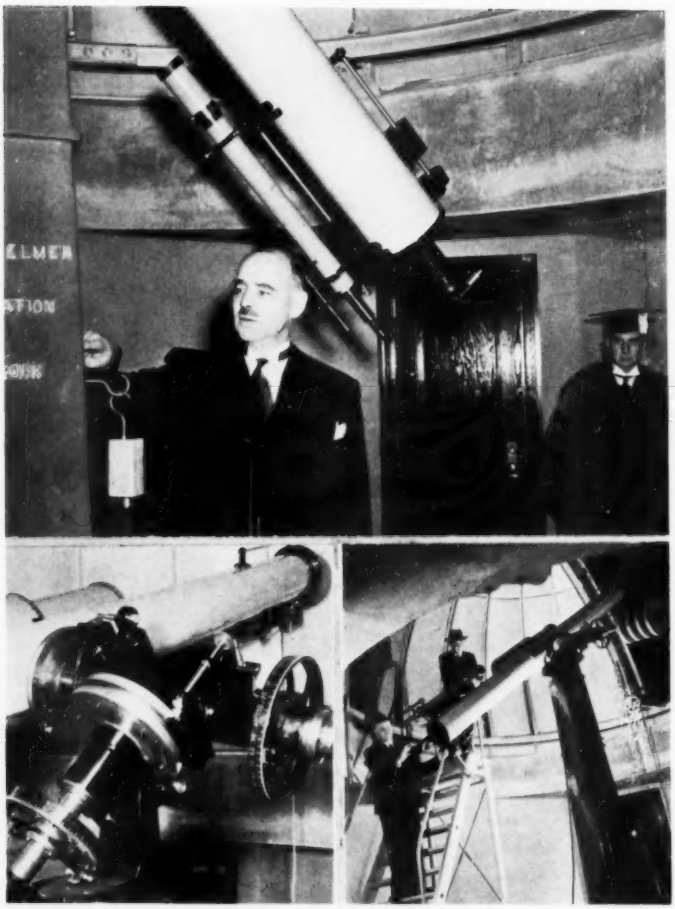
*Above.* View of the Observatory (from the N.W.).
*Below.* Mrs. Hume Cronyon (left) and Mrs. Dunlap entering the building after the ceremony outside.

*Journal of the Royal Astronomical Society of Canada, 1940.*

PLATE XXI

MRS. HUME CRONYN SIGNING THE VISITORS' BOOK

PLATE XXII



VIEWS OF THE 10-INCH TELESCOPE

*Above.* Mr. R. H. Cronyn pressing the button to start the driving mechanism of the telescope, Chancellor Cockshutt at rear.
*Below, left.* The "head" of the mounting of the telescope, showing the driving mechanism. The synchronous motor is within the pier.
*Below, right.* Dr. Kingston at the eyepiece of the telescope, Rev. W. G. Colgrove, higher up. The Schmidt camera is on the farther side of the telescope tube.

*Journal of the Royal Astronomical Society of Canada. 1940.*

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Vol. XXXIV, No. 9 NOVEMBER, 1940 WHOLE No 298

# THE OPENING OF THE HUME CRONYN MEMORIAL OBSERVATORY

By H. R. KINGSTON

(With plates XIX-XXII)

ON the afternoon of Friday, October 25th, the Hume Cronyn Memorial Observatory of the University of Western Ontario was dedicated in a brief ceremony held in the open air on the Observatory grounds. The weather man co-operated perfectly by providing an ideal day, bright and warm, more like August than late October. A goodly number of friends gathered for the occasion. Out-of-town guests included Mrs. David Dunlap and Dr. and Mrs. C. A. Chant representing the David Dunlap Observatory, members from the centres of the Royal Astronomical Society at Toronto and Hamilton, and Dr. S. A. Mitchell, director of the Leander McCormick Observatory, University of Virginia. Colonel Henry Cockshutt, Chancellor of the University, was chairman of the meeting, but was unable to speak because of a severe cold. The speakers were therefore introduced by the Vice-Chancellor, President W. Sherwood Fox, in the following programme.

PRESIDENT FOX: It is most appropriate that we are permitted to call upon the Rector of the Cronyn Memorial Church of this city to take part in the dedication ceremonies of the Cronyn Memorial Observatory. Canon Quintin Warner will now offer the invocation. After the Chairman of the Board of Governors has accepted the Observatory, Canon Warner will pronounce the prayer of dedication.

CANON QUINTIN WARNER, Rector Cronyn Memorial Church: The heavens declare the glory of God; and the firmament sheweth his handywork. (Psalm 19:1)

*Let us pray*

Almighty and eternal God, Maker of all things, Judge of all men, before Whom all things in heaven and earth shall bow and obey, we consider Thy heavens, the work of Thy fingers, the moon and the stars which Thou has ordained, and ask,—What is man that Thou art mindful of him, and the son of man that Thou visitest him? And yet Thou hast graciously promised in whatever place even two or three of Thy faithful servants shall assemble, to be in the midst of them. Be present with us, we pray Thee, who are now gathered together to dedicate this memorial to Thy Glory and in remembrance of a devoted servant of our country. Accept, O Lord, this service at our hands and bless it with such success as may most tend to Thy Glory and the edification of Thy people—through Jesus Christ our Lord. Amen.

Blessed be thy name, O Lord, that it hath pleased Thee to put it into the hearts of Thy servants to build this observatory to Thy honour and service; and grant that all who shall enjoy the benefit of this work may show forth their thankfulness by making such use of it that, their vision being extended far beyond the confines of this world in which we live, they may learn to relate all that they may be taught in this University to the extension of Thy Kingdom in the hearts of men—through Jesus Christ our Lord. Amen.

PRESIDENT FOX: Mrs. Hume Cronyn, the generous donor of this charming observatory, is, like all true philanthropists, exceedingly modest. While gladly giving to the University this beautiful building and its major equipment, she shrinks from the conspicuousness involved in making an address at a public presentation. We respect her feelings. Reading her mind we endeavour to give the substance of what we divine she would have said had she ventured to speak for herself.

We have built this small observatory as a memorial to my husband, the late Hume Cronyn. He was always deeply interested in the University of Western Ontario and its progress. For that reason I hope this observatory will be a useful and enduring addition to the University's equipment. I have pleasure in presenting the keys to the Chairman of the Board of Governors.

ARTHUR T. LITTLE, Chairman of Board of Governors of the University, in accepting the generous gift, addressing Mrs. Cronyn, spoke as follows:

The Board of Governors of the University of Western Ontario thank you and your family most sincerely for the gift of this, "The Hume Cronyn Memorial Observatory". This delightful and practical building, so complete in its modern telescopic equipment, provides for us much-needed facilities that we had little hope of attaining by our own devices.

It will not only be a source of instruction and inspiration to the students and faculty of the University, but will bring pleasure and benefit to those citizens of this community, who are interested in astronomy.

It is most fitting that the Memorial to the late Major Hume Blake Cronyn should take this form, for we all recall his active interest in the endeavours of his fellow-citizens in all fields,—social, educational, financial, and military. Particularly it comes to mind that he was largely responsible for the establishment of The National Research Council, now giving a service to this country and the Empire that cannot be overestimated.

We remember gratefully that during his lifetime Major Cronyn endowed for this university the appropriately named "The Honourable Edward Blake Scholarships" in Economic and Political Science, thus displaying a confidence in our young university that was truly inspiriting.

We are deeply conscious of what this Memorial means to you and the members of your family, and the compliment you have paid us in entrusting to us, not only its proper care, but its most advantageous use in the field of that mysterious and fascinating science—astronomy.

We are indeed grateful, Mrs. Cronyn, and you may rest assured that nothing will be left undone to merit your trust.

CANON QUINTIN WARNER: (*Prayer of Dedication*)

In the Faith of Jesus Christ we dedicate this Observatory to the Glory of God and in honoured memory of Hume Cronyn—In the Name of the Father and of the Son and of the Holy Ghost. Amen.

PRESIDENT FOX: Now that the Board of Governors has accepted possession of the Observatory, they entrust it to the Department of Mathematics and Astronomy for its use and administration. The chief of this department, Professor H. R. Kingston, is himself an enthusiastic and competent astronomer who has for many years given leadership in the study of astronomy both to his students and to interested local groups in Canada. Having followed the development of this observatory from the stage of plans to the stage of completion he is the person the best qualified to describe the building, its apparatus and the service it will render to the University and the interests of astronomy.

Professor H. R. KINGSTON then addressed the gathering:

Mr. Chancellor, Mrs. Cronyn, Honoured Guests, Ladies and Gentlemen: Do dreams ever come true? To-day we are able to say that at least one dream has even *more* than come true. For many years the Department of Mathematics and Astronomy of the University of Western Ontario and the members of the London Centre of the Royal Astronomical Society of Canada have "dreamed a

dream and seen a vision"; to-day that vision is a reality in this beautiful Hume Cronyn Memorial Observatory and telescope made possible by the generosity of Mrs. Cronyn.

It will be recalled that Mr. Cronyn, as London's representative at Ottawa during the latter part of the Great War, consistently urged upon the Federal Government the pressing need of a research bureau for the study of Canadian problems. His untiring efforts led to the formation of the Research Council of Canada, an organization which has already rendered a priceless service to this country. A little over a year ago, on learning of the efforts of the University to secure a telescope, Mrs. Cronyn decided to erect, as a memorial to Mr. Cronyn and his life work, an observatory equipped with a suitable telescope. In December the contract for the telescope and revolving dome was let to the Perkin-Elmer Corporation of New York, and the contract for the building to the Putherbough Construction Company. A word of genuine thanks is due each of these organizations and also to Mr. E. Roy Moore and Co., the architects, for their untiring efforts and patience in producing a building both beautiful and substantial, and a telescope excellent in quality and convenient to operate; and for the gift which made this entire project possible, we are grateful beyond words to Mrs. Cronyn.

Perhaps a word about the telescope may be of interest. There are two kinds of telescopes—reflectors which have mirrors, and refractors which have lenses. Ours is a refractor which has a lens—in reality a double lens—10 inches in diameter. This is the largest lens the glass discs for which have ever been made in the western hemisphere. The telescope is electrically driven to follow the motion of the sky and is also electrically controlled. Attached to the telescope is the latest invention for photographing the heavens, a Schmidt camera, a really marvellous type of instrument which has been available only during the past four or five years. With it we shall be able to obtain remarkable photographs of the Milky Way, comets, star clusters, and other universes at distances so great that their light requires hundreds of thousands of years to reach us.

Beyond the foyer on the first floor of the building are an office and a library, both of which are turned into instrument rooms for this occasion to-day. The basement contains a lecture room, a small workshop and a kitchenette. On the second floor at the back is an observing deck, and off the telescope room there is a very convenient dark room.

With this equipment we shall be able to conduct some valuable research in certain definite fields, as, for example, in the problem of obtaining the life history of variable stars. The principal purpose of this equipment is, however, to aid in the teaching of astronomy. It will enable our students to observe and study at first hand, as well as from books, many of the other worlds in our solar system and in the great universe beyond. Then, too, it will be a great stimulus to the work of the local Astronomical Society. Further, we wish the observatory to provide a cultural service to all the citizens of London and vicinity, and we shall implement this wish to the utmost of our ability. The observatory will be open to the public on Saturday evenings except during the winter months. Further, it is planned to open the building on one other evening each week to accommodate

any organization whose members desire to view through the telescope some of the wonders of the sky.

The observatory has already received some further gifts. An excellent four-inch telescope has been presented by Dr. and Mrs. W. E. Saunders; this has already been of immense service to us. A group of models constructed by Rev. W. G. Colgrove has been given for demonstrating astronomical phenomena; these are the most helpful instruments for this purpose that I have ever seen. A set of striking astronomical transparencies, some of which you will see on the walls of the foyer, have been made from negatives loaned to us through the courtesy of the staff of the David Dunlap Observatory. The members of that staff have also made helpful suggestions in connection with the whole project. A very unusual gift is the Dresden meteorite, provided by the Directors of the London Life Insurance Company. A mirror and eyepiece for a reflecting telescope have been given by Mrs. (Dr.) Sparks of St. Mary's; copies of paintings of famous scientific events, by the Bausch and Lomb Optical Company of Rochester, N.Y.; and other items of equipment by members of our local Astronomical Society. To all these persons we offer our sincere thanks.

But I must not weary you further. I know you would much prefer to see the building and telescope for yourselves. It will be open for inspection immediately at the close of these ceremonies, again after Convocation this evening, and of course, to-morrow (Saturday) evening.

May I again express to you, Mrs. Cronyn, the most sincere thanks of the University, as well as of the citizens of London and of Western Ontario for this beautiful and valuable gift. I trust that we may so use it that it will bring to our students and to our citizens in general the maximum of pleasure and profit, and to you and to your family and friends a very real and abiding satisfaction.

PRESIDENT FOX: The nearest neighbour observatory is the great, imposing David Dunlap Memorial Observatory of the University of Toronto at Richomnd Hill. We welcome its representatives who have graciously joined us to-day—Mrs. David Dunlap and Dr. C. A. Chant, now Director Emeritus. We shall listen with pleasure to the greetings brought by Dr. Chant on behalf of himself and his colleagues.

DR. C. A. CHANT:

It is with great pleasure that I bring to you hearty greetings from the University of Toronto, and more particularly from the David Dunlap Observatory. In doing this I have the cordial approval of President Cody. Also, I feel I am justified in adding the congratulations of the members of the Royal Astronomical Society of Canada. Professor Kingston has been very active in the work of the Society and was the president of the entire Society in the years 1930 and 1931. Its members, who are distributed across our broad country, will rejoice in the wonderful reward of his labours here.

A short time ago I came upon a pamphlet published by the Dominion Govern-

ment embodying the observations made in Canada of the transit, or passage, of the planet Venus across the face of the sun on December 6, 1882. This astronomical event was considered very important. It was thought that it offered a method of determining more accurately the distance of the earth from the sun, which is the astronomer's yard-stick for measuring the universe. I was interested to see a list of the instruments used. Woodstock and Quebec each had an 8-inch telescope, Fredericton a 7-inch, Kingston a 6½, Montreal a 6¼, Toronto and Whitby each a 6-inch, and there were several smaller ones. The telescope at Toronto was imported from England and installed specially to observe this phenomenon.

The majority of these telescopes belonged to colleges of various types and they have been used to some extent in the work of teaching, but not in serious and continued efforts at giving instruction in astronomy. Not one of these telescopes is in the same class with the 10-inch instrument of the Hume Cronyn Memorial Observatory, in power, in mounting or in convenient housing. Indeed this is the most effective observatory of instruction in the Dominion. Perhaps it marks the beginning of a new era. The observatory, as has been already remarked, is not designed primarily for research, but many important investigations have been made with more modest equipment and I confidently expect some enthusiasts in this community to make distinguished observations in the future.

During the last half-century astronomy has undergone a pretty complete transformation, largely through the application of the methods of physics to astronomical problems. This branch of the subject is called astrophysics. During this time Canada has taken an honourable place in astronomical research. The new observatory will do valuable service in inspiring and training workers in this fascinating science.

One of the objects of the observatory is, I understand, the dissemination of a knowledge of the heavens among the people. This I consider very important. One is continually surprised at the ignorance of many educated people in regard to astronomical matters. I think it is because they do not give them a thought. They never look up at the sky and consider its mysteries. Throughout the centuries, discoveries in astronomy have powerfully moulded human thought; indeed they have been the deciding factors in philosophical and theological belief. Each individual person is an organic unit in the universe and it surely behooves him to realize his relation to it.

These are serious times, with disturbing world-happenings every day. We must not lose our mental equilibrium. I contend that the study of astronomy will help us to preserve this. It supplies the mind with noble subjects for quiet consideration. Astronomy reveals the relative smallness of the individual person, but its also teaches the great fact that we live in a universe of law and order.

Long may the Hume Cronyn Memorial Observatory carry on its important and beneficient work!

PRESIDENT FOX: Remoter neighbours as well as near neighbours are represented here to-day. Dr. S. A. Mitchell has come to us all the way from the Leander McCormick Observatory of the University of Virginia to convey a message of congratulations. As originally a Canadian having intimate associations with London, the Cronyn family and the University, he is a most welcome and appropriate guest. Since he is to be presented adequately this evening upon his induction into the doctorate of the University, I shall content myself with this brief introduction and call upon him now to bring us a few words from the University of Virginia. To-night we shall have the pleasure of hearing him speak at length when he delivers the Convocation address. This address entitled "The Astronomer and his Telescope" will, unlike the usual Convocation address, be illustrated by lantern slides.

S. A. MITCHELL, PH.D., LL.D., Director of the Leander McCormick Observatory, University of Virginia:

I am proud to be with you to-day on the occasion of the dedication of the Hume Cronyn Observatory, as a reminder to you and as an evidence of the great and lasting friendship that has existed for more than a hundred years between this great nation Canada, an important entity in the British Empire, and the great Republic to the south of you. On this auspicious occasion I bring greetings from the Leander McCormick Observatory which at one time possessed the largest and finest telescope in the world. I also bring greetings from a famous American educational institution, the University of Virginia.

I am proud that I can come to you to-day not as a stranger but almost as one of your own. You have been very indulgent at several different times in listening to me lecture on astronomy, especially on my hobby, eclipses of the sun. I regard myself as very fortunate in having been born on "the old Ontario Strand" in Kingston. I think I was lucky to come along before educational frills had diluted the high merit of the public school system of Ontario, which in the years now known as the Gay Nineties gave a very thorough training in the fundamentals of a broad education. Although a member of a large family with money none too plentiful, I was permitted to go to Queen's University and I hold the same degree won a few years later by Dr. Neville and Dr. Kingston. Upon my graduation, now many years ago, Canada was not equipped to give me any higher education and so I went to Johns Hopkins in Baltimore, from which famous university I hold the same degree of Doctor of Philosophy won later with great distinction by President Fox.

My home town, Kingston, was represented in the Dominion Parliament during my boyhood years by a great and famous Canadian patriot, Sir John A. Macdonald. I well remember him. Sir John A. was a wily old politician. When he came to Kingston, as he did frequently, he nearly always stopped at a third-

rate hotel. He knew everybody by name, shook hands with everybody, patted the women on the shoulders and kissed the babies.

Near my present home in Virginia was born a great statesman, a true philosopher and a sound scientist, Thomas Jefferson, the third president of the United States. He lies buried at his home, Monticello, only three miles from my own home on what is known as Observatory Mountain or Mount Jefferson. This gifted statesman, who to my mind was the greatest president the United States has ever had, described with meticulous care the tombstone that now stands in the family burying-plot at Monticello. On this granite pedestal are the words, "Thomas Jefferson, author of the Declaration of Independence, of the statute for religious freedom in Virginia, and father of the University of Virginia." You may be interested in knowing that Mr. Jefferson regarded the greatest achievement of his eventful life was the founding of a seat of learning. You may also be interested in knowing that Jefferson's University, as it is called, has an honour system not only for the conduct of examinations but for all student self-government, which has been in successful operation for nearly one hundred years, in fact, since 1841, the year that Queen's University was founded.

My *alma mater*, Queen's, and my present academic home, Virginia, have recently been linked together through the actions of a distinguished American citizen, Franklin Delano Roosevelt. A year and half ago when Queen's gave President Roosevelt an honoray degree, he spoke in most emphatic terms and gave warning to the dictators of Europe that Canada and the United States had a single thought and purpose of defending themselves against possible aggression by the foes of democracy. On June 11 of this year, in making the Commencement address at the University of Virginia, he spoke in ringing words denouncing Italy, which on that very day had administered a cruel blow to the cause of freedom by sticking a dagger into the back of France.

At home, in addition to being the director of an observatory with a fine refracting telescope, twenty-six inches in aperture, I serve as the local U.S. Weather Bureau observer for which latter position I receive from the United States government the princely salary of no dollars per year. As a result of the dual life thus led, I am frequently called up on the telephone by one of the dear ladies of the Garden Club who informs me that they are planning to hold an open-air flower show at Monticello six weeks hence and so she would like to know whether it is going to rain on that particular day. When I tell her quite frankly that I do not know, the disappointment in her voices that trickles in over the telephone tells me that she is saying to herself, "Well, what in the world is a big telescope good for if it cannot see things at a distance!"

Let us take our thoughts now for a little while away from wars and rumors of wars that have taken possession of us all, and let our minds dwell, according to the poet Wordsworth, on "the silence that is in the starry skies, the sleep that is among the lowly hills." It has been my good fortune in life to have seen much of the world, to have visited in most of the great cities of this and other lands and to have met many distinguished men and women. Judging from the eminent men I have met it is my considered opinion that there is no group of people anywhere in the world who have so much pleasure and profit in their lives, in a

word, who have as much real fun, as the professional astronomers. None of us get tremendous wealth and have the power that money can bring, but speaking for myself, I hope that the modest little addition I have been able to make to the sum-total of human knowledge has been of greater lasting value than if I had devoted my life to the task of accumulating filthy lucre. I am in the habit of saying that astronomers are lucky for two reasons: first, that most of their refined researches appear to have little practical value that may be measured by financial returns, and hence there are no trade secrets; and second, because the world over we form a small and select group of friends working with enthusiasm to pass along the torch of learning, burning ever a little more brightly from our efforts.

Into this select group we gladly welcome this youngest observatory and we admit it to all the rights and privileges appertaining thereto, of good fellowship and hearty co-operation. The Hume Cronyn Memorial Observatory will serve a dual purpose: first, in the stimulation of good teaching, and second, in research. We who have been in the teaching profession all our lives have learned that the surest method of keeping out of a rut in our methods of instruction is to do some-worth-while to brush the cobwebs out of our brains, and this something we dignify by the name of research. In quantity we shall not expect this new observatory to equal the output of some of the great American observatories for the simple reason that their annual budgets are several times the total cost of this observatory. It will not be necessary to try to compete with the two Canadian observatories with great telescopes at Victoria and Toronto. Fortunately, there are many lines of astronomical research that can be well carried on with smaller instruments. We in Virginia are doing our best to demonstrate that work of first-class quality may be done with a telescope that many astronomers regard as an obsolete type, namely, a visual refractor. In quality, however, we shall be satisfied here with nothing but the best.

My time is up and I must stop, but before I do so I would like to remind my friend Dr. Kingston that the eminent Irish astronomer, the late Sir Robert Ball, prescribed a very simple life for the professional astronomer. All that is required is that the astronomer spend each night and all night in observing the stars and then spend the balance of the twenty-four hours doing arithmetic. Surely no one can ask for a simpler life than that, especially if the temperature may be 26 degrees below zero—as it was years ago when I was young and worked all night at the Yerkes Observatory.

And now it gives me great pleasure to ask my own nephew, Richard Hume Cronyn, to put the Hume Cronyn Memorial Observatory into operation by starting the motor that slowly moves the telescope.

Congratulatory telegrams and letters were read from Dr. J. A. Pearce, Director of the Dominion Astrophysical Observatory, Victoria; C. A. McDonald, President Vancouver Centre of the R.A.S.C.; Dean A. Vibert Douglas and Professor K. P. Johnston, Queen's University; Robert Peters, President Victoria Centre, R.A.S.C.;

Miriam S. Burland, President Ottawa Centre, R.A.S.C.; Dr. J. W. Campbell, Honorary President Edmonton Centre, R.A.S.C.; R. Meldrum Stewart, Director of Dominion Observatory, Ottawa; Dr. R. K. Young, Director of David Dunlap Observatory, Richmond Hill; and Frederick L. Troyer, Toronto.

After the singing of the national anthem the Observatory was opened for inspection. Mr. R. H. Cronyn, son of the donor, turned the switch putting into operation the driving motor of the telescope, and expressed the hope that the telescope would be a valuable aid in enhancing the service which the University is rendering to her constituency.

The ceremony was followed by a dinner given at the Hunt and Country Club by President and Mrs. Fox.

The Autumn Convocation held in Convocation Hall in the evening was in part a continuation of the afternoon ceremony. Dr. Mitchell was presented with the degree of Doctor of Laws, honoris causa, and gave the Convocation address on the topic "The Astronomer and his Telescope," the address being illustrated with lantern slides. After Convocation the Observatory was again open to the public who greatly enjoyed views of Saturn and Jupiter through the new telescope.

# ANDREW FREDERICK HUNTER

By C. A. Chant

ANDREW FREDERICK HUNTER was born in Innisfil Township, Simcoe County, Ontario, on December 31, 1863, and died in Toronto on October 19, 1940. His father, William Telfer Hunter, was of Scottish descent while his mother was of Pennsylvania Dutch ancestry. He attended school at his country home and at the near-by town of Barrie, and then went to the University of Toronto, where he followed the honour course in Mathematics and Physics and graduated B.A. in 1889, preceding the present writer by one year. He obtained the M.A. degree in 1892, the subject of his thesis being "The polarization of light".

In 1889 Mr. Hunter purchased *The Barrie Examiner* (established by W. M. Nicholson in 1864), which he edited and published until 1895 when he sold it to J. A. MacLaren. Beginning October 24, 1889, and continuing until February 5, 1891, Mr. Hunter published weekly articles on the history of his native County. Addressing the County Council on January 30, 1908, Hon. J. S. Duff, a minister of the Ontario Government and a native of the County, urged that these articles be collected and extended to form a complete history of the County. In May, 1908, the Council authorized this and in the following year appeared "The History of the County of Simcoe" in two well-illustrated and well-printed volumes. To produce this work Mr. Hunter spent many hours in patient investigation of old records.

Mr. Hunter was a member of the Ontario Archaeological Association and was its treasurer for some years. He had a special interest in Huron Village Sites on which he wrote a number of valuable articles. Some account of them is given in the first volume of his "History". On this subject he was a recognized authority. In 1913 he removed to Toronto to become Secretary and Librarian of the Ontario Historical Society.

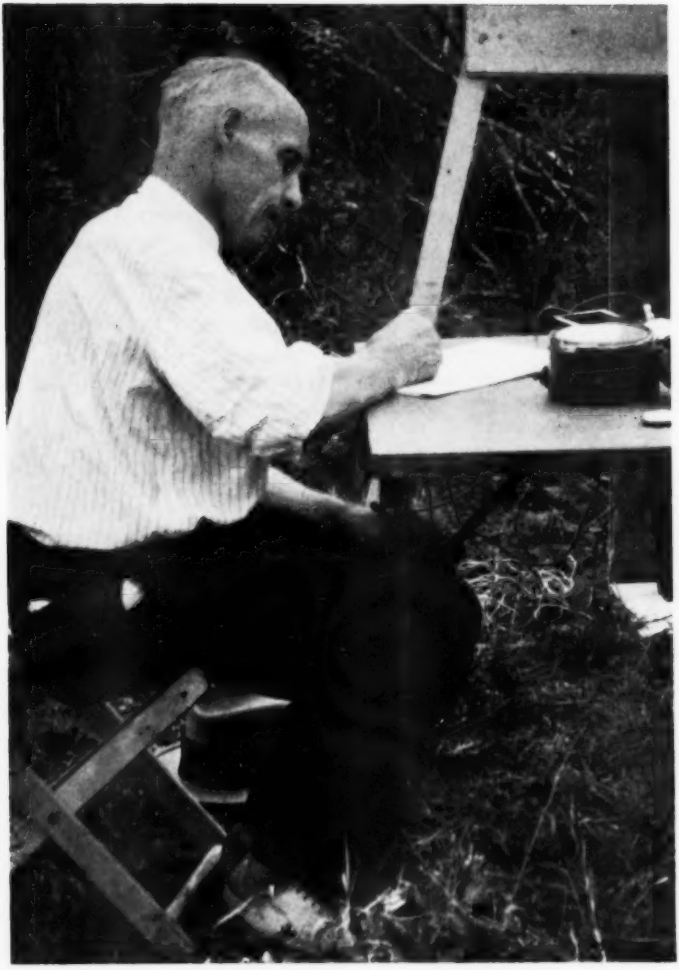
From 1904 to 1908 Mr. Hunter was associated with the Canadian Geological Survey. He was for many years a member of the Royal Canadian Institute, continuing so until 1931. On May 6,

1890, he was elected a member of the newly incorporated Astronomical and Physical Society of Toronto, but before this, while he was an undergraduate, he was one of the scientific group which used to meet for discussions. He was an active and useful member of the Society. He was Recorder in 1918, General Secretary 1920-23, and President in 1926, '27.

As the result of a stroke he was in poor health for a number of years, and then, after a serious illness extending over a period of seven weeks, he passed away. He was borne to his grave in the quiet Sixth Line Cemetery, Innisfil, by four nephews and two grand-nephews. He was unmarried.

Mr. Hunter was quiet and reserved in manner but had a keen mind and was a good observer. He contributed to this JOURNAL some twenty notes on halos, auroras and related phenomena; and his paper on "A Layman's Diary of Halley's Comet" in volume 4 (1910) is an admirable account of what one could see with the unaided eye.

PLATE XXIII



CHARLES CAMPBELL SMITH
b. December 31, 1872; d. July 10, 1940.

Photograph by the Canadian Government Motion Picture Bureau at the eclipse camp near St. Alexis-des-Monts, P.Q., August 1932.

*Journal of the Royal Astronomical Society of Canada, 1940.*

# CHARLES CAMPBELL SMITH, 1872-1940

By D. B. Nugent

(With Plate XXIII)

SUDDENLY stricken while playing golf on the morning of July 10th last, Charles Campbell Smith, a former distinguished member of the staff of the Dominion Observatory at Ottawa, passed away on the golf course. His death brought to a close the life of one who had been keenly interested in astronomy and the work of the Observatory. About three years after the organization of the Observatory in 1905, he joined the staff of the Meridian Circle and Time Service division and assisted in the erection and the adjustment of the instrument with which for many years he was to be so closely associated, first as an observer and later in charge of the work. At the time of his retirement on superannuation, January 1, 1938, he had been for a number of years in charge of the division of Position Astronomy and Time Service, a very important branch of the work of the Observatory.

Of Scottish descent, Mr. Smith was born at Brampton, Ontario, on December 31, 1872. His early education was received in the schools of his native town, and after teaching school for a few years he entered the Faculty of Arts of the University of Toronto, from which he was graduated in 1902, with first class honours in mathematics.

Following his graduation he went to Ottawa and that year began his professional career on the staff of the Topographical Surveys Branch of the Department of the Interior, as a draughtsman on British Columbia survey work. For the next three years he was employed as a field assistant with survey parties during the summer months and on office computations and draughting during the balance of the year. In February, 1906, he passed his final examination for admission as a Dominion Land Surveyor and was given charge of some subdivision work and resurveys in Southern Alberta, west of Macleod.

Resigning from the Topographical Surveys Branch, he joined the Meridian Circle and Time Service division of the Dominion

Observatory in 1908, and was one of three observers using the Cooke transit instrument for the determination of clock correction and, in co-operation with the field observers, the determination of the longitude of various places in eastern Canada.

The meridian circle instrument which had been received at the Observatory in October, 1907, was in process of being mounted and adjusted for observations when Mr. Smith joined the staff. Owing to injury to the graduated circles while in shipment from the makers, pivot inequalities, and damage by frost to the cement piers on which the instrument was mounted, considerable time was required to make the necessary repairs, and it was not until March, 1910, that the meridian circle was put into use. During that interval Mr. Smith did a large amount of the work of measuring and correcting the instrumental errors.

In the spring of 1912 he suffered a very severe bereavement in the death of his wife, the former Rebecca Elliott, of Brampton, Ontario, which affected him so keenly that later in the year, desiring a change of environment, he resigned his position at the Observatory. He went to Vancouver, B.C., where he opened an office as Land Surveyor. For several years he practiced his profession in that province with great credit to himself, making numerous important surveys for the provincial government and for private companies.

However, his yearning to be working with the instrument at Ottawa, to which he had given so much of his energy and thought during its erection, was so great that in 1919 he returned to the Observatory and resumed his work as an observer with the meridian circle. At that time a programme of observations to determine more precisely the right ascension and the declination of some 3,000 stars, many of which were being used in latitude determinations by the field observers, was in progress with the meridian circle. This programme required about 30,000 observations which were completed by 1924 and the necessary computations well advanced. In December, 1924, Mr. Smith was given charge of the Meridian Circle and Time Service division, succeeding Mr. R. Meldrum Stewart, who had been appointed Director of the Observatory. He immediately initiated a new programme of fundamental obser-

vations with the meridian circle and work on it was being carried on at the time of his retirement.

At the meeting of the International Astronomical Union held at Cambridge, England, in July, 1925, it was decided to carry out an extensive scheme of longitude determinations in October and November, 1926. The principal objects of the scheme were to test the Wegener theory of continental drift and to improve adopted longitudes. Over forty observatories, including Ottawa, agreed to take part. Under Mr. Smith's direction star observations were taken and wireless time signals received at Ottawa, and also at a field observatory at Vancouver, B.C., where Mr. Smith was personally engaged in the work. The Observatory's stations at Ottawa and Vancouver combined with Greenwich and Tokyo to form one of the world encircling belts. When the results of the observations at the various observatories were compiled by the Bureau International de l'Heure in Paris, they were not as uniform as had been expected. Though the observations had been carried out with the greatest accuracy obtainable, it was deemed desirable to repeat the measurements in 1933 and to include more observing stations. It was particularly desired to have another world encircling belt, consisting of the Cape of Good Hope, Adelaide, Wellington, and Buenos Aires in the southern hemisphere. Again, under Mr. Smith's supervision, the Dominion Observatory occupied the stations at Ottawa and Vancouver, and very satisfactory star observations and wireless time receptions were obtained.

In August, 1932, he was a member of the party from the Observatory which went to St. Alexis des Monts, Quebec, to observe the total eclipse of the sun. He was especially charged with providing the correct time for the observers, but also gave much valuable assistance in getting the camp laid out and the various instruments set up and made ready for the observations.

During his long connection with the Dominion Observatory he was actively interested in the Ottawa Centre of the Royal Astronomical Society of Canada, and by his lectures and his work on its council did much to promote a wider interest in astronomy. He was President of the Ottawa Centre in 1929 and 1930, and was honoured by election as Fellow of the Royal Astronomical Society

of Canada in 1922. He was also a member of the American Astronomical Society and a member of the Canadian National Committee of the International Astronomical Union.

Owing to the exacting nature of his duties at the Observatory, he did not have time to devote to many social activities. He enjoyed outdoor life and was an enthusiastic curler and golfer. He also took a keen pleasure in attending football and hockey games and followed closely the fortunes of teams representing his Alma Mater.

Mr. Smith was a gentleman of the highest integrity who never spared himself but gave of his best in everything that he did. His sincerity, his devotion to his work, and his unassuming character, won for him the respect of those with whom he was associated and they regret that he was not spared to enjoy longer the pleasures of a well-earned relaxation. His death has deprived Canadian science and the Astronomical Society of a faithful worker.

In 1921 he married Rose Patton of Ottawa, who survives him. He is also survived by a son of his former marriage, Wallace, an officer in the Royal Canadian Air Force, at present stationed at Camp Borden. Mr. Smith was a member of the United Church and a largely attended funeral service was held in Ottawa and the remains were taken to Brampton for burial in the family plot.

Dominion Observatory,
Ottawa, Canada.

# VISUAL PHOTOMETRY OF VARIABLE STARS

By H. Boyd Brydon

"In this Discourse I do not undertake to say all that is known or may be said but I undertake to acquaint the Reader with many things that are not usually known . . . and I shall leave gleanings and observations enough to be made out of the experience of all that love and practise this recreation to which I shall encourage them"—*The Compleat Angler.*

## I

### Photometry with Naked Eye or Telescope

FOR the amateur astronomer the interests and attractions of variable star observing are many. There is the fascination of watching the wax and wane of light from some giant star many light-years distant, the careful charting of its changes, the endeavour to learn their cause, the knowledge that in co-operation with many others he is contributing to the understanding of the evolutionary process of the universe. Nor are these alone his reward. They bring in their train satisfaction in work done well despite imperfect tools, perseverance, keener perception, training in the recognition of pattern in the intricate groupings of the stars among which he identifies the variable and in the exercise of unbiassed judgement in estimating its magnitude; a wider mental horizon and a deeper sense of the sublimity of nature; attributes which inure to his benefit throughout his daily work and life.

We observe variable stars to accumulate facts. Before the meaning of stellar variation and the light it throws on the nature of the universe can be discussed we must know why stars vary. Before we can discuss WHY they vary we must learn HOW they vary. Much has been done but more remains to do. Over 4,000 new variables have been found in the last ten years; more than one a day. The total is now over 10,000 and of not one-tenth can we say we know all that they can tell us.

The telescopes in the great observatories of the world are swamped with work that only they can do, striving to answer questions for which they are especially fitted. They have not the time to give to this less difficult but equally necessary work and the burden of observing these variable stars has been placed largely

upon the hosts of amateur observers which, large as they are, are still far short of being adequate to the task. Splendidly are they doing their job but reinforcements are greatly needed. The work is far from being confined to those possessing large telescopes. They have a very special opportunity in the observation of very faint stars but, as in olden days the peripatetic cheap-jack sold "spectacles to suit all sights," there are variable stars to suit all optical powers, including the naked eye, and for all, pitfalls lie in the way to accuracy.

It is the purpose of this paper to discuss some of the pitfalls met with in the visual photometry of long period and irregular variables and novae. Methods employing photography or the photoelectric cell are outside its scope. Nor is it intended at this time to discuss methods for the reduction of observations to the formation of light curves, which has been treated in great detail by Dr. Caroline Furness in her "Introduction to the Study of Variable Stars" (1915).

From the manner in which they vary, E. C. Pickering in 1880 placed variable stars in five general classes:

I. New or temporary stars.
II. Long-period variables.
III. Irregular variables.
IV. Short-period variables (Cepheids).
V. Eclipsing variables (Algols).

Subsequently Ludendorff devised a more detailed classification. His ten classes with their type stars are:

I. New or temporary stars: Nova Aquilae, 1918.
II. Nova-like variables: T Pyxidis, RS Ophiuchi.
III. R Coronae stars: Stars usually at constant maximum with occasional sharp minima at long, somewhat irregular, intervals: R Coronae Borealis.
IV. U Geminorum stars: Stars usually at constant minimum with occasional sharp maxima, at long, somewhat irregular, intervals: U Geminorum.
V. Mira stars: Stars having a range of several magnitudes with fairly regular periods ranging from 100 to 600 days: o Ceti.
VI. $\mu$ Cephei stars: Red stars with irregular variations of a few tenths of a magnitude: $\mu$ Cephei.
VII. RV Tauri stars: Irregular variables of spectral types G and K in which a shallow minimum often occurs between two deep minima: RV Tauri.
VIII. Long-period Cepheids; also known as "classical cepheids," stars having regular periods of 1·5 to 65 days with a range of about 1·5 magnitudes: $\delta$ Cephei.

IX. Short-period Cepheids: also known as "cluster variables," stars having regular periods of less than one day with a range of about 1 magnitude: RR Lyrae.

X. Eclipsing variables: Double or multiple stars whose light-variation is not necessarily intrinsic but is caused by one star passing in front of a companion; very regular periods: $\beta$ Persei.

Light-curves of the different types of variable stars are given in text-books on astronomy and more fully in the works named in the footnote.[1]

When variable stars are arranged according to number and period a remarkable grouping appears, as in figure 1.[2]

Analysis of the data from which figure 1 was prepared brings to light a remarkable relationship, see especially column 9 of Table I.

TABLE I

CHIEF TYPES OF VARIABLE STARS

| Class | Type Star | No. Known 1935 | Light Range | | Period, Days | | | |
|---|---|---|---|---|---|---|---|---|
| | | | Mag. | Brightness Max./Min. | Limits Lower | Limits Upper | Most Frequent | No. of Cycles in 280 days |
| Long period | Mira | 2144 | 4·5 | 63 | 32 | 560 | 280 | 1 |
| Cepheid | $\delta$ Cep. | 287 | 0·8 | 2·1 | 3 | 32 | 5·6 | 50 |
| Eclipsing | Algol | 873 | 1·0 | 2·5 | 0·2 | 30 | 2·8 | 100 |
| Cluster | RR Lyr. | 620 | 1·0 | 2·5 | 0·2 | 0·9 | 0·56 | 500 |

Drs. Payne-Gaposchkin and Gaposchkin prefer a classification based more directly upon the general relationship existing between these stars and arrange them as in Table II.[3] They consider that such a grouping holds a broader physical significance than other classifications and avoids the formation of "small groups of un-

[1]Russell, Dugan and Stewart, "Astronomy," Ch. 22, and the works mentioned in reference[3].

[2]Permission to use this figure and the data in Table I was kindly afforded me by Dr. Paul W. Merrill and The Macmillan Co.

[3]In the study of variable stars, Dr. Paul W. Merrill's "The Nature of Variable Stars," Dr. Caroline Furness' "Introduction to the Study of Variable Stars" and "Variable Stars" by the Drs. Payne-Gaposhkin and Gaposchkin, in the order named, will be found a valuable course of reading. The frequent references in the last named work to the work of the A.A.V.S.O. is convincing testimony to the contribution to astronomy made by this association of amateur observers.

certain affiliations by assigning one star to a small class called after another star which it somewhat resembles," of which they give an amusing instance "taken at random from Prager's Catalogue for 1936: TU Octantis is described as of the XX Ophiuchi type; XX Ophiuchi is described as of R Coronae Borealis type and R Coronae Borealis is described as irregular(!)."

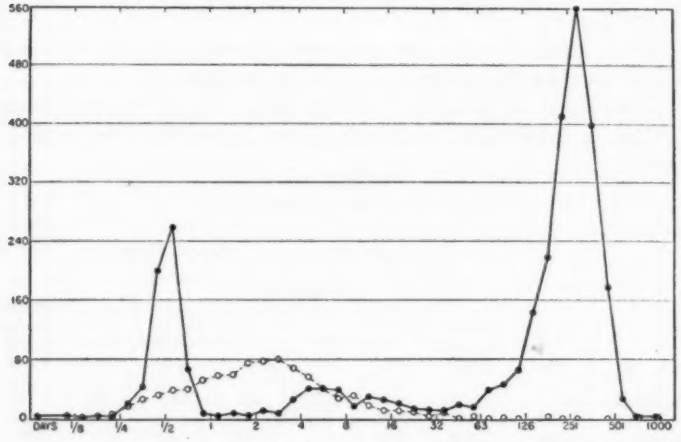



Fig. 1.—Numbers of variable stars having various periods. Open circles represent eclipsing variables; solid circles all other variables. (By permission of The Macmillan Co.)

TABLE II

GAPOSCHKIN CLASSIFICATION OF VARIABLE STARS

| A Geometric Variables | B The Great Sequence | C Cataclysmic Variables | D Nebula Variables |
|---|---|---|---|
| Eclipsing Stars<br>Ellipsoidal "<br>Obscured " (?) | Long-period Variables<br>Semi-regular Variables<br>Cepheid Variables<br>Cluster-type Variables<br>(Irregular Red Variables) | Novae<br>SS Cygni Stars<br>(R Cor. Bor. stars) | |

The general routine of variable star observing is well described

n a paper by D. W. Rosebrugh[4] which gives many valuable hints to help the beginner on his way to success in this most useful astronomical activity, not the least being the recommendation to join the American Association of Variable Star Observers, familiarly known as "the A.A.V.S.O." one of the ten or more societies scattered round the world which are engaged in this work. He will immediately receive charts and instructions and his Regional Director is always available to help him out of any difficulties with explanation and advice.[5]

The A.A.V.S.O. Star Charts, issued under the auspices of Harvard College Observatory, are in five series, "a", "b", "c", "d" and "e", and are eight by ten inches in size.

The "a" charts cover an area of about fifteen degrees square and contain stars down to about the seventh magnitude. As they are intended for naked eye and field glass observation north is at the top and east on the left hand side.

The remaining maps being for use at the telescope have south at the top and east at the right hand side.

The "b" charts contain stars between the sixth and tenth magnitudes and serve for 3-in. and 4-in. telescopes. They cover an area about 3 degrees square. Figure 2 shows a typical chart of this series.

The "c" charts are a comparatively new series. They are 2 degrees square. The stars on them range from about 7·5 mag. to about 12·0 mag. A small "finder" chart is printed on the back of each.

The "d" charts reach from about 9·0 mag. to about 15·0 mag. and serve for 12-in. telescopes. They cover an area of about 1 degree square but in addition have a square with 30′ sides outlined on them extending 15′ each way from the centre where the variable is placed.

The "e" charts are intended for use with large telescopes when variables are faint, and need not be discussed here.

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[4]D. W. Rosebrugh: "When you have finished your Telescope, what next"? This JOURNAL, v. 29, p. 153, 1935.

[5]Application for membership should be made to Mr. Leon Campbell, Recorder, A.A.V.S.O., Harvard College Observatory, Cambridge, Massachusetts, U.S.A.

On the charts the magnitudes of selected comparison stars are given to tenths of a magnitude but without the decimal point. Thus 118 and 95 mean 11·8 mag. and 9·5 mag. Visual magnitudes

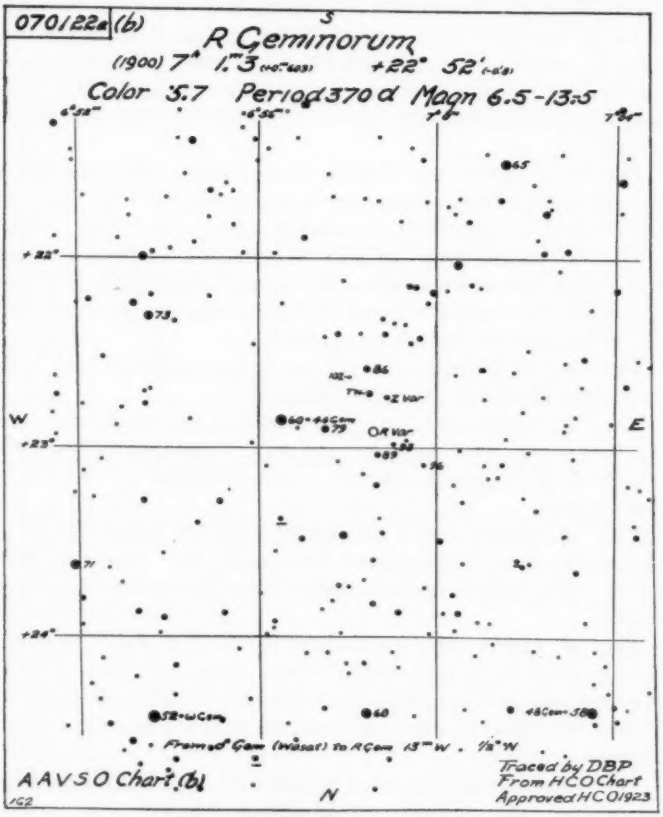


Fig. 2.—Specimen of "b" type chart.

are generally given on charts of series "a", "b" and "d" and photovisual magnitudes on "c" charts.[6]

[6]Visual magnitude is the brightness as directly estimated by the naked eye or with a telescope. When measured instrumentally by a photometer it is called

The "c" charts give the spectral type of the variable, the "a", "b" and "d" charts its colour according to the Osthoff Scale. This scale of colours which has been widely used was determined by H. Osthoff from many years of study of the colours of stars[7] and is given in Table III.

TABLE III

OSTHOFF'S COLOUR SCALE

| | |
|---|---|
| $0^c$ | white |
| $1^c$ | yellowish white |
| $2^c$ | white-yellow; yellow and white in equal parts |
| $3^c$ | bright or clear yellow |
| $4^c$ | pure yellow |
| $5^c$ | dark yellow |
| $6^c$ | reddish-yellow; yellow the stronger |
| $7^c$ | red-yellow; yellow and red in equal parts (orange) |
| $8^c$ | yellowish-red; red the stronger |
| $9^c$ | red with a tinge of yellow |
| $10^c$ | red |

Discussing this scale, Osthoff says: "With the understanding that my remarks apply only for a given telescope, my 4-in., Sirius is the whitest star $=0{\cdot}6^c$, next Rigel, $0{\cdot}9^c$ and the most strongly coloured star is 19 Piscium $=8{\cdot}8^c$. The variable stars, among which is $\mu$ Cephei are not included here. Herschel's "garnet star" ($\mu$ Cephei) remains one of the strongest coloured of naked eye stars but the colours are not easily recognized with the naked eye. Osthoff says further that 19 Piscium is not a full red but is 8.8 on his scale.

All charts give the right ascension and declination of the star as of 1920.0. The "c" and "d" charts always, and the "a" and "b" charts sometimes add the corrections for precession which are given as for a period of 10 years.

The number at the top left and bottom right hand corners is the Harvard designation of the star, not a catalogue number. The first four figures are the hours and minutes of right ascension, the last two, the degrees of declination, thus 180445 means that the right ascension of the star is $18^h\ 04^m$, and its declination is between

the photometric magnitude. Photo-visual magnitudes are obtained photographically by means of isochromatic plates and a colour filter and correspond approximately with the light-sensitiveness of the eye. See Norton's "Star Atlas."

[7] *A.N.*, v. 153, No. 3657-58, p. 142, 1900.

45° and 46° north. When the whole number or the last two figures are underlined or in italics the declination is south.

For identifying the variable it is very convenient to have one or more circles drawn on the chart with diameter equal to the field of the finder. The scale is obtained from the distance between the lines of declination given on the chart. Each circle should be placed to contain an easily recognizable pattern of stars; the variable should be a point in one such pattern but the circle need not be centred on it.

The diameter of the finder field is found by timing carefully the passage across it of an easily recognizable star near the equator, the telescope being stationary the while. The average time in minutes multiplied by 15 and divided by the cosine of the star's declination is the diameter of the field in minutes of arc. It is well to determine this value for all eyepieces in the main telescope.

It generally takes a long time to identify a variable with certainty on the first attempt but one soon learns to recognize these patterns in the finder. It is rendered easier if the east-west line of the chart is held parallel to the direction in which the stars in the neighbourhood of the variable sought are moving in the telescope. Merrill[8] remarks "after pointing the telescope with care to the known position of the variable, a competent observer will be reasonably safe in assuming that the desired object is in the field of view . . . if he is searching for a long period variable among the dozen or more stars which may meet his eye, one will usually be set apart by its marked red or deep orange colour. That is very probably the variable sought. If there are two or more red stars in the field the observer will have to glance at his chart."

Having found the variable which at first is principally a matter of patience and perseverance, the most satisfactory method of estimating its magnitude, now that well determined magnitudes for comparison stars have robbed the "step" method of much of its usefulness,[9] is Pickering's "decimal" method.

Two comparison stars are needed, one of magnitude $f$, fainter

[8] "The Nature of Variable Stars," p. 67. (By permission of The Macmillan Company.)

[9] For a detailed description of the "step" method see Furness, "Introduction to the Study of Variable Stars", chaps. V and VI.

and one of magnitude $b$, brighter than the variable $v$. After one or more intent looks at each star the observer concludes that the variable is fainter than $b$ by a certain number of tenths $n$, of the difference between $f$ and $b$. Then

$$v = b + n\,(f - b).$$

Thus if $b = 7{\cdot}8$ mag. and $f = 8{\cdot}4$ mag. and it is finally concluded that $v$ is fainter than $b$ by about $0{\cdot}7$ of the difference between $f$ and $b$ we have $v = 7{\cdot}8 + 0{\cdot}7\ (8{\cdot}4 - 7{\cdot}8) = 8{\cdot}2$ mag.

Evidently the smaller the difference in magnitude between the two comparison stars the more accurate will be the estimate of the magnitude of $v$.

It is desirable to use not less than three pairs of comparison stars which may be $A - B$, $B - C$, and $C - A$. If the resulting magnitudes are in reasonable agreement, and experience must guide in determining the meaning of "reasonable," their average may be accepted as the magnitude of $v$. If, however, one value is clearly out of line with the other two, an additional estimate should be made using other comparison stars. If the new result agrees with the other two the inconsistent value should be discarded at once, not left until a later time.

ALL observations should be entered in pencil in the rough observing book and ALL should be entered in ink in the record of observations, including those discarded, that fact being shown by a line drawn through them, leaving them otherwise legible. The time of the observation entered in the rough book may be the standard time for the place of observation but this should be converted into Julian time (both being shown however) for the record book.

(To be continued)

# THE METEOR OF MAY 7, 1928

By Fletcher Watson

ON the evening of May 7, 1928, a brilliant meteor moved over eastern Canada and left in its wake a train visible for an hour and a half. Through fortuitous circumstances a photograph of this meteor train, taken from Chicoutimi, P.Q., came only recently to the Harvard Observatory from Mr. A. Stewart McNichols of Montreal. Inquiries revealed no reference to the meteor or the train in either the published or unpublished astronomical literature. Since long-enduring, sunlit trains are among the rarest of meteoric phenomena, an attempt to investigate this meteor has been made despite the intervening years. A number of letters and newspaper accounts were collected at the Dominion Observatory, Ottawa, at the time of the meteor's appearance, but Mr. Douglas Barlow and Dr. Ralph DeLury found them insufficient for a determination of the meteor's path. Mr. R. Meldrum Stewart, Dominion Astronomer and Director of the Dominion Observatory, generously loaned me all these reports for comparison with the photograph taken at Chicoutimi. Mr. McNichols and Mr. René Bélanger of Chicoutimi supplied the necessary geographical information with great accuracy.

The photograph (A, Figure 1) taken in strong twilight, shows the train almost directly over the Cross of Sainte Anne of Chicoutimi, bearing N 40° 25.1′ W. The illuminated portion of the Cross measures 32 by 22 feet while the over-all dimensions are 45 by 24 feet. From the point at which the camera was operated the base of the Cross is 1° 04′ above the true horizon. On a very contrasty enlargement of the photograph the steeple of the Church of Sainte Anne can be discerned at the position of the arrow, bearing 7° 45.5′ north from the Cross. Thus the scale of the original photograph is established as 0°.405 per millimetre.

The instant at which the meteor appeared cannot be determined precisely. From the letters the earliest time is "about 7.30 E.S.T.", while, more frequently, "7.30 or a little later" and "about 7.30 to 7.40" indicate that an adopted time of 7.30 p.m. for the meteor can-

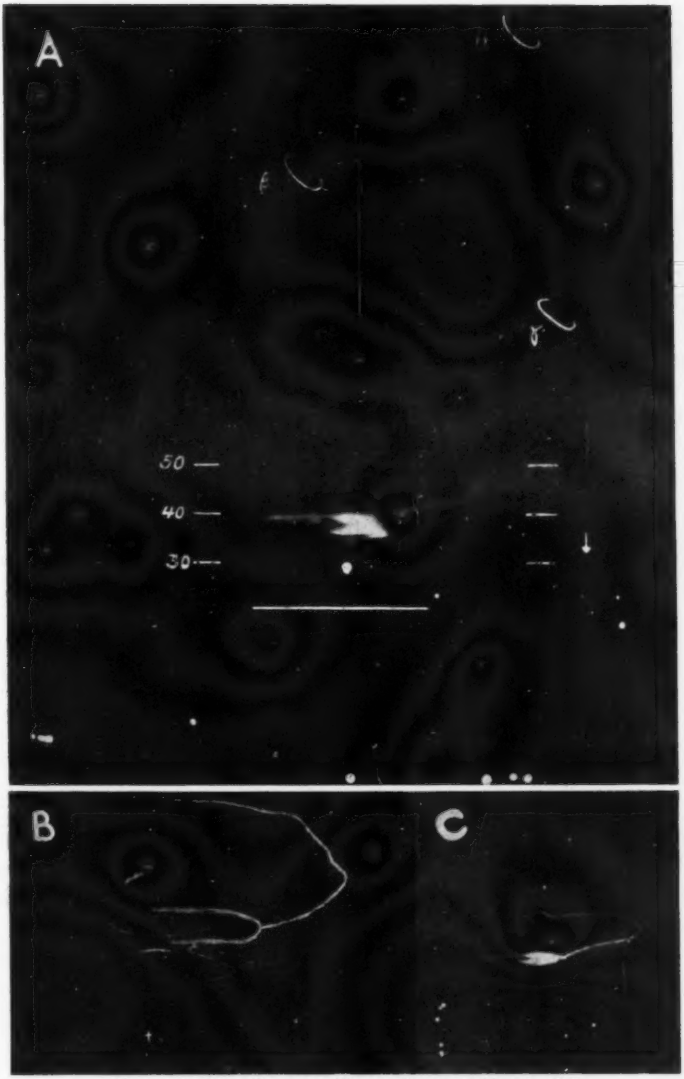


FIGURE 1.—THE ENDURING METEOR TRAIN OF MAY 7, 1928.

A. Photograph taken by Mr. A. Stewart McNichols from Chicoutimi, P.Q., over the cross of Sainte Anne. The positions of Beta and Theta Persei and of Gamma Andromedæ are marked, as well as the adopted scale of height in miles and the true horizon.

B. Sketch of meteor train as seen from Chicoutimi by Professor Victor Tremblay at 7.45 p.m.

C. Snapshot of train by Abbé Drolet, from Chicoutimi at 8.30 p.m. The upward swirl has been strengthened by retouching.

not be far wrong. On the photograph, three faint out-of-focus star trails were detected, as marked upon A, Figure 1, and identified as Beta and Theta Persei and Gamma Andromedæ. Their positions indicate that the photograph was started within a few minutes of 7.35 and their lengths indicate that the exposure time was approximately three minutes. This time of exposure is consistent with Mr. McNichols' statement that the photograph "was taken some five or ten minutes after the meteor had fallen".

The bearing of the train as seen from Chicoutimi locates one "line of position" very accurately. Furthermore, Professor Victor Tremblay, who observed the meteor from the Grand Seminaire of Chicoutimi, approximately a half-mile from the location of Mr. McNichols' camera, reports* that the meteor descended nearly vertically, but moved slightly towards the right (north). Thus Chicoutimi lay nearly on, but slightly north of, the projected line of flight. Although the letters generally stated only that the meteor or the train had been observed or that the meteor exploded, a few also included the general direction of the train. These were:

St. Augustine (Lake St. John), P.Q., N 38° 20′ W.

Pembroke, Ont., "descended behind a small peak of the Laurentians and for as long as the matter appeared red it had the appearance of a volcano in action".

Rouyn, P.Q., N 10° E.

Bourkes, Ont., N 20° E, by compass, apparently corrected for variation.

Kirkland Lake, Ont., N 14° E.

Figure 2 illustrates how the observations cross the line from Chicoutimi. There can be little doubt that the meteor and its train were situated over the eastern side of James Bay and that the bright portion of the train hung over longitude 78° W, latitude 53° N. If the observation of Professor Tremblay is interpreted as indicating a slope of 80° to the horizontal as seen from Chicoutimi, the meteor was moving almost directly towards Fort George. Estimates and sketches of the meteor indicate that the true slope of its path was between 30° and 40° to the horizontal; 40° has been adopted.

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*Le Naturaliste Canadien*, vol. LV, p. 74, 1928.

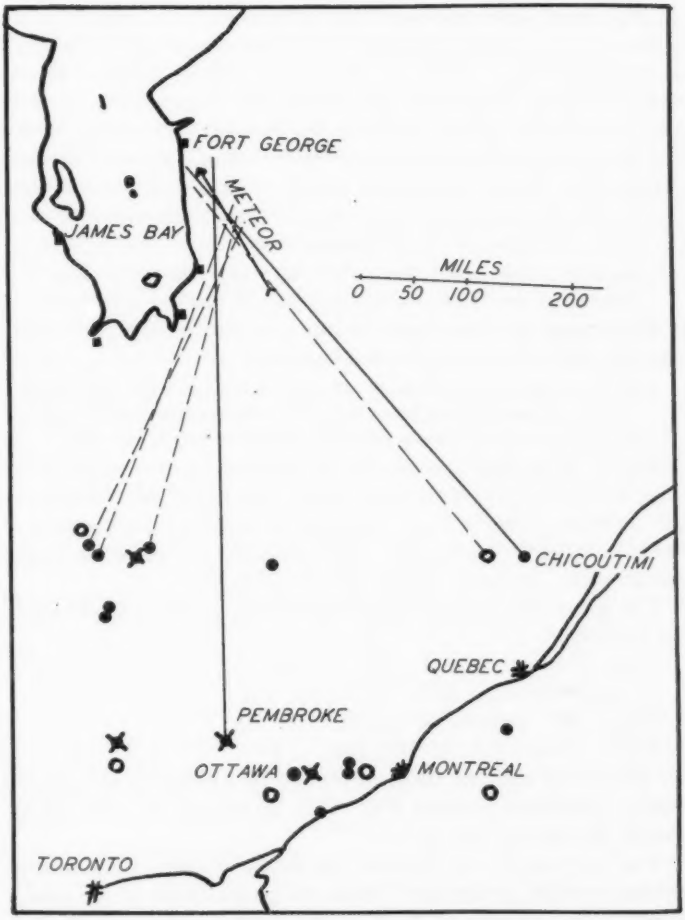


FIGURE 2.—Observations of the meteor and its train, with the adopted line of flight indicated by the heavy dashed line with arrow-head. Open circles indicate "train observed", filled circles indicate "meteor observed", while crosses indicate "burst observed". Plotting was done on map of Province of Quebec, 1936, issued by the Minister of Lands and Forests.

The visual observations proved insufficient for a solution of the height of the meteor at any point. Some information about the height of the end-point and of the burst may, however, be derived from the reports that, as seen from Haileybury and Dunchurch, Ont., the meteor died away before reaching the horizon, while from Navan, Ont., it was seen to burst. At appreciable distances from the observer the curvature of the earth depresses the surface below the horizon by amounts depending upon the distance. After allowance for mean horizontal refraction, 36′, the depressions are:

| Distance | 100 | 200 | 300 | 350 | 400 | 450 | 500 | 550 | miles |
|---|---|---|---|---|---|---|---|---|---|
| Depression | 0.4 | 3.2 | 8.3 | 12.0 | 16.5 | 21.5 | 27.1 | 33.3 | miles. |

If the apparent horizon is assumed to be a "sea horizon", the minimum heights of the end point and burst are:

End point: Haileybury, distance 415 miles, minimum height 18.0 miles
Dunchurch, distance 405 miles, minimum height 17.2 miles;
Burst: Navan, Ont., distance 540 miles, minimum height 32.2 miles.

Professor Tremblay's sketch (B in Figure 1) shows the train extending to his apparent horizon, which, like that of Mr. McNichols, was probably a degree above the true horizon. At the distance of 400 miles from Chicoutimi this would place the end point not higher than 25 miles—probably between 20 and 22 miles.

The somewhat uncertain astronomical data on the fireball may be summarized:

Time—7.30 p.m., E.S.T., May 7, 1928
Groundpoint—long. 78°.7 W, lat. 53°.5 N;
Slope—40°; azimuth of radiant, S 35° E
Radiant near—R.A. $12^h\ 00^m$, Dec. + 10°.

For this radiant and time the elements of a parabolic orbit are approximately: perihelion distance 0.92 A.U., inclination 4°, atmospheric velocity 12 miles per second.

The train was by far the most conspicuous feature of the meteor, remaining visible until 9 p.m. Since the ground-point of the meteor as well as the azimuth and the slope of its path have been determined, the apparent altitude of any portion of the path as seen from Chicoutimi could be computed. Allowance for differential refraction introduced a slight curvature into the relationship, which passes through the following points:

| Apparent altitude from Chicoutimi | 0′ | 60′ | 120′ | 180′ | 240′ | 300′ | |
|---|---|---|---|---|---|---|---|
| True height | 19.0 | 26.8 | 34.0 | 40.1 | 46.2 | 52.2 | miles. |

The highest angular elevation on the photograph from Chicoutimi is only 282′, corresponding to a height of 50.2 miles for the top of the train. In A, Figure 1, the adopted scale of heights and the position of the true horizon are indicated. Between the top and bottom of the bright central portion, which consists of three "clouds" or "spirals", the height ranges only from 40.3 to 35.5 miles. Since the explosion occurred higher than 32.2 miles, it was probably associated with this region of bright train. The heights of the train as a whole are somewhat less than those for the similar sunlit train of March 24, 1935, investigated by Störmer,* (i.e., between 50 and 60 miles).

As many of the observers suspected, the train was illuminated by sunlight. As seen from the ground directly below the bright portion of the train, 78° W, 53° N, the sun at 7.30 E.S.T. was still a few degrees above the horizon. The times of "sunset" at various heights are readily computed; allowance has been made for the semi-diameter of the sun and for twice normal horizontal refraction, a total correction of 1° 28′:

| E.S.T. | 8.40 | 9.00 | 9.20 | p.m. |
|---|---|---|---|---|
| Altitude of "sunset" | 20 | 39 | 60 | miles. |

The disappearance of the train at 9 p.m. is not surprising, for at that time the earth's shadow was engulfing the bright portions lying between 35 and 40 miles high.

The rapid distortion of this train is especially noteworthy. The photograph in A, Figure 1, was taken not more than fifteen minutes after the meteor passed, yet the horizontal spread is 422′, which, at 400 miles, is equivalent to 49 miles. Thus between the altitudes of 46 and 39 miles the minimum differential wind velocity was 200 miles per hour. If this velocity were maintained during the three-minute exposure, the image should be considerably blurred in the horizontal direction. Yet the upward swirl is rather sharply defined, despite the imperfections of the lens and focus. Comparison of the photograph with the nearly-simultaneous sketch of Professor Tremblay (B, Figure 1) suggests that the vagueness of the extension towards the

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left in the photograph resulted from motion during the exposure. He described the distortion of the train as follows:

"The luminous column retained its regular form only for some moments, one saw it slowly form a great curve, then reproduce different designs resembling in turn V, or M . . . ". Visual observers at other positions reported the train as "spiral", "zigzag", "wavy", or "corkscrew", "to settle down in a wrinkled form", and "to settle down and spread out". Unfortunately no times or oriented sketches are available for comparison with the observations from Chicoutimi.

One further observation of the train is available, but it is difficult to reconcile with the others. Abbé Drolet of the Grand Seminaire of Chicoutimi took a snapshot of the train (C, Figure 1), first reproduced in *Le Naturaliste Canadien, (ibid.)*. The time stated for the exposure is 8.30 p.m., but the shape of the train is remarkably similar to that in the photograph taken near 7.35 by Mr. McNichols. Perhaps the time given is in "daylight time", but this seems unlikely as Professor Tremblay of the same institution in his paper (1928) clearly stated the time as later than his sketch. Furthermore there is only the slighest indication of the twilight band so conspicuous in the photograph by Mr. McNichols, while the lower portions of the train have disappeared. Unfortunately the Cross of Sainte Anne does not show and there are no landmarks by which the orientation and scale of the picture can be determined. If the hour was actually 7.30 E.S.T., the meteor must have appeared somewhat earlier. If, however, the time was 8.30 E.S.T., the rate of horizontal train distortion was large for the first few minutes after the meteor appeared but diminished rapidly.

This investigation would have been impossible without the assistance of Mr. A. Stewart McNichols and of Mr. René Bélanger. Professor Victor Tremblay kindly loaned the originals of the illustrations used in his article of 1928; while the Director of the Dominion Observatory, Ottawa, generously made available all the visual observations filed at that Observatory.

Possibly this report will serve as a reminder of other observations or photographs that might be made available for a further discussion of this interesting meteor.

Harvard College Observatory.

# METEOR NEWS

**Observations relating to meteors and meteorites are cordially invited.**

## The Leonid Fireball of November 17, 1939

Three meteor trains, observed by Mr. Jack Grant in Orillia, Ontario, were described in the Journal last year, vol. 33, p. 439, 1939. In connection with one of these it was stated that Mr. R. M. Dole of Portland, Maine, had observed a bright fireball with a train visible for just over forty minutes and it was suggested that these two observations were of the same object. Since then Mr. Dole has very kindly sent me both his photographic and visual observations and these leave no doubt that he recorded the same meteor as Grant. An observation from the Dominion Observatory in Ottawa has also been received. This was obtained during the Leonid programme described by Miss Burland and Mr. Thomson in the Journal, vol. 34, p. 261, 1940.

Unfortunately, the exact time of this brilliant meteor is in doubt despite the fact that it was observed from three stations. Grant's watch stopped temporarily some time during the night so that according to his timing the meteor might have appeared any time between $2^h\ 14^m$ and $2^h\ 19^m$ E.S.T. Nov. 17, 1939. Dole's original report gave $2^h\ 08^m$ as the time but later he admitted that he read his watch hurriedly and in great excitement and it might well have been $2^h\ 18^m$. The Ottawa record sheet gives the time as $2^h\ 24^m\ 34^s$ but this was recorded just at the end of 25 minutes of cloudy sky during which observations were not made, hence the reading may have been in error by 5 minutes. On a careful study of the plotted positions from the three stations and a comparison of the estimated brightness and train duration, it was evident that the records refer to one object in spite of the discrepancies in the time. A time of appearance of $2^h\ 19^m$ E.S.T. was adopted as the best compromise.

The observations of the meteor were as follows:

*Portland, Me.*—Observer R. M. Dole. A brilliant Leonid fireball, mag. −10. Left a short train which assumed circular form and remained visible for over 40 minutes, finally drifting behind trees on N horizon. Photograph

taken with Contax camera, Sonnar F/1.5 lens, at $2^h\ 38^m$. Camera exposed for 2 min. while held in hand.

*Orillia, Ont.*—Observer Jack Grant. Leonid meteor, definitely brighter than mag. −3, green in colour, path length 5 deg., altitude low about 4 deg. Train was visible in binoculars for 5.5 min.

*Ottawa, Ont.*—Observer Emile Potvin. Leonid meteor, mag. −4, colour blue, then white. Train lasted to $2^h\ 27^m\ 15^s$, no drift noted.

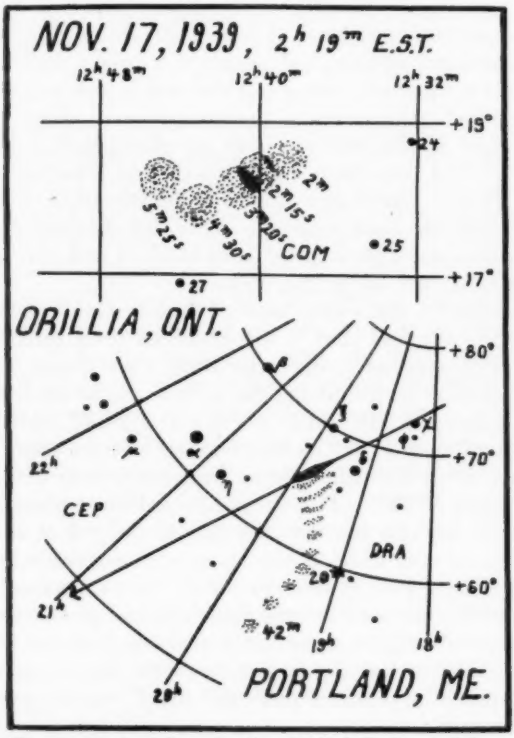


Fig. 1.—Train drifts of a Leonid fireball observed from two stations.

The plots of train drift as observed at Orillia and Portland are reproduced in figure 1, the numbers beside the trains indicating

minutes after the meteor appeared. The time given for disappearance of the train at Ottawa may be subject to the same error as that for the appearance of the meteor but possibly not when train durations at the two other stations are considered. The photograph taken at Portland is reproduced in figure 2. The star trails are somewhat out of focus and show considerable drift. This is not due to diurnal motion but to a slow shifting of the camera since it was held in the hand for the 2 minutes exposure. The position of the train as measured on the photograph is R.A. $19^h\ 29^m$, Dec. 59°.3 N.

Fig. 2.—Photograph of a Leonid train taken by R. M. Dole in Portland, Me., on Nov. 17, 1939.

The solution for the height of the train was complicated by the uncertainty concerning the exact time, by the fact that Grant did not plot the original meteor path, by the long base-line (460 miles) from Orillia to Portland, and by the lack of any train plot from Ottawa. Since the meteor was observed near the horizon at both Orillia and Portland the spherical triangle formed by these two stations and the sub-point of the brightest part of the meteor's path was solved. This gave a position for the meteor directly over lat. 46°.7 N., long. 71°.0 W., which is a point just a few miles

south-east of Quebec City. Heights for the train and the meteor's path were then determined by several methods. The observations from the three stations were not in exact agreement so that a probable error of at least 5 miles is likely present in most of the heights determined. The following are considered to be the best average values:

| | | |
|---|---|---|
| Meteor— | height of appearance | 95 miles |
| | height of disappearance | 35 " |
| Train — | initial height | 80 " |
| | height after 5.5 min. | 70 " |
| | height after 40 min. | 40 " |

The radiant could not be exactly determined from the visual observations but it was very near the average Leonid radiant for the date at an altitude of 40°, azimuth 275°, giving an air path 95 miles in length.

As will be seen from the above results the train was considerably higher than the average. This unusually great height is corroborated by the fact that on Dole's plot of the meteor path the train is located in the first half of the path rather than near the end, as is usually the case. The motion of the train was approximately straight down for the first five and a half minutes when it was plotted from Orillia, the minimum velocity being well over one hundred miles an hour. This general motion apparently continued and the final train height is computed on this assumption. It may, however, have drifted somewhat to the north during the 40 minutes Dole observed it, in which case it was actually higher than 40 miles at the time of disappearance. The diameter of the train as plotted by Grant was approximately 4 miles and this checks quite closely with the size determined from the plot by Dole.

The estimates of brightness as observed from Orillia and Portland are consistent. Grant's recorded brightness probably corresponds to at least mag. −4, perhaps even brighter. The meteor was definitely bluish so that atmospheric absorption in Orillia would cut down the apparent brightness by about 4 magnitudes and the increased distance by another magnitude and a half. The absolute magnitude of this fireball, that is its magnitude as seen in the zenith at a distance of 60 miles, was probably in the neighbourhood of −12. The Ottawa estimate would lead to a

result several magnitudes fainter but it is almost certain that this observation was influenced by local cloud and haze conditions.

It is rather surprising that no reports of this fireball were received from the neighbourhood of Quebec City where it must have been a very brilliant sight. The explanation probably lies in the late hour and in the possibility of clouds in that district. I would like to thank Mr. Dole for sending me his interesting observations which have made possible the further discussion of this meteor.

### Observations by M. Louis Mathieu, St. Ephrem Stn., P.Q.

One of the most conscientiously carried out series of visual meteor observations I have yet received from any Canadian observer has been made by M. Louis Mathieu during the months of August, September and October of this year. He observed at St. Ephrem Stn. in Quebec at lat. 46°4′N., long 70°55′W. and recorded meteors on a total of 43 nights in this three-months' period, on several occasions working right through from dusk till dawn. Observations were carried out over a total of 125 hours and in this this time 901 meteors were seen, these all being plotted on star maps.

M. Mathieu's record is all the more commendable since he works under certain difficulties. He has no timepiece and no modern means of illuminating his star charts while observing. His times for the start and the finish of observations are given by noting the positions of certain stars or by moonrise and moonset and the ending and beginning of twilight. A complete summary of this work is given in Table I. The periods of observation and the total minutes observed have been computed from the descriptions which M. Mathieu sent in with his records. These will, of course, be subject to some slight uncertainty since they were not timed with a watch but the percentage error in the case of the long observing spells will be small. The total number of meteors observed is given in the fourth column and for most of August I have also, from an examination of the maps, divided these into Perseids (P) and Non-Perseids (N). The uncorrected hourly rate is given in column five in all cases where the observations were continued for some length of time and the weather factor was high. The last column contains the weather factor which has been estimated from M. Mathieu's

TABLE I

VISUAL METEOR OBSERVATIONS BY M. LOUIS MATHIEU
ST. EPHREM STATION, P.Q.

| Date (1940) | Local Mean Time | Total Time Observed | No. of Meteors Observed | | | Hourly Rate | Weather Factor |
|---|---|---|---|---|---|---|---|
| July 8..... | 20.00— | | 2 | | | | |
| 9..... | 20.00— | | 2 | P | N | | |
| Aug. 3–4..... | 20.30—24.00 | 180 m | 16 | (11 | 5) | 5 | 8 |
| 4–5..... | 20.30—23.30 | 180 | 12 | (5 | 7) | 4 | 9 |
| 6–7..... | 1.00— 3.00 | 100 | 14 | (6 | 8) | 8 | 9 |
| 7–8..... | 20.30— 2.00 | 300 | 46 | (33 | 15) | 9 | 10 |
| 8–9..... | 21.00— 3.00 | 300 | 51 | (35 | 16) | 10 | 9 |
| 9–10..... | | 30 | 4 | (3 | 1) | | 3 |
| 10–11..... | 23.30— 4.00 | 250 | 47 | (40 | 7) | 11 | 10 |
| 12–13..... | 20.30—22.30 | 120 | 6 | (6 | 0) | | 3 |
| 13–14..... | 23.00— 2.30 | 180 | 21 | (18 | 3) | 7 | 10 |
| 15–22..... | | | 22 | (6 | 16) | | |
| 26–27..... | 20.00—23.30 | 210 | 18 | | | 5 | 10 |
| 27–28..... | 20.00— 0.30 | 270 | 27 | | | 6 | 10 |
| 28–29..... | 20.00— 3.00 | 400 | 50 | | | 8 | 10 |
| 29–30..... | 20.00— 4.00 | 440 | 48 | | | 7 | 10 |
| Aug. 31–Sept. 4.. | | | 6 | | | | |
| Sept. 5– 6..... | 20.30— 2.30 | 320 | 26 | | | 5 | 10 |
| 22–23..... | 19.00—21.30 | 140 | 8 | | | 3 | 10 |
| 27–28..... | 19.00—21.30 | 120 | 5 | | | 3 | 10 |
| 28–29..... | 19.00— 2.30 | 370 | 23 | | | 4 | 10 |
| 29–30..... | 19.00—22.30 | 180 | 12 | | | 4 | 8 |
| Sept. 30–Oct. 1.. | 19.00—22.30 | 150 | 10 | | | 4 | 8 |
| Oct. 1– 2..... | 19.00—22.30 | 140 | 30 | | | 13 | 7 |
| 2– 3..... | 19.00— 2.00 | 330 | 23 | | | 4 | 10 |
| 4– 5..... | 20.00— 4.30 | 420 | 65 | | | 9 | 10 |
| 9–10..... | 1.30— 4.30 | 150 | 33 | | | 13 | 10 |
| 10–11..... | 3.30— 5.00 | 70 | 11 | | | 9 | 10 |
| 13–14..... | 4.30— 5.00 | 30 | 14 | | | | 10 |
| 19–20..... | 18.30—19.30 | 60 | 3 | | | | 3 |
| 20–21..... | 18.30—19.30 | 60 | 1 | | | | 2 |
| 21–22..... | 18.00—20.00 | 60 | 3 | | | | 6 |
| 22–23..... | 18.00—19.00 | 40 | 2 | | | | 2 |
| 23–24..... | 21.30—22.30 | 40 | 7 | | | | 6 |
| 24–25..... | 18.30—20.00 | 75 | 3 | | | | 6 |
| 27–28..... | 18.30—23.30 | 250 | 18 | | | 4 | 10 |
| 27–28..... | 24.00— 2.00 | 120 | 25 | | | 12 | 10 |
| 28–29..... | 19.00—24.00 | 40 | 4 | | | | |
| 28–29..... | 1.00— 5.30 | 210 | 39 | | | 11 | 10 |
| 29–30..... | 18.30— 5.30 | 550 | 65 | | | 7 | 10 |
| 30–31..... | 18.30— 5.30 | 600 | 79 | | | 8 | 10 |

Totals..125 hrs. 901 meteors

description of observing conditions. Since he avoided moonlight nights and usually mentioned clouds when they were present, the factor has been set down as 10 when nothing was said to the contrary.

The over-all mean uncorrected hourly rate is 7 per hour. The rates were unusually high on and near Oct. 9-10, but the maps show no particular evidence of any Draconids so that this shower was not responsible for the large numbers of meteors seen.

Estimates of brightness and apparent velocity of each meteor on rather arbitrary scales were made from Oct. 13 on. These have been summarized in Table II, together with the magnitudes which probably correspond to the description of luminosity. The percentage

TABLE II

DISTRIBUTIONS OF MAGNITUDES AND APPARENT VELOCITIES FOR 263 METEORS OBSERVED OCTOBER 13-31, 1940

| Probable Magnitude | +5 | +4 | +3 | +2 | +1 | 0 | −1 | −2 | −3 | −4 |
|---|---|---|---|---|---|---|---|---|---|---|
| Description | very faint | faint | rather faint | medium brightness | | rather bright | bright | less bright than ♃ | brighter than ♃ | bright as ♀ |
| No. of Meteors.. | 20 | 109 | 64 | 46 | | 10 | 8 | 3 | 2 | 1 |
| Description. | very fast | fast | rather fast | rather slow | | slow | very slow | | | |
| Percentage of Meteors. | 2 | 52 | 25 | 11 | | 9 | 1 | | | |

of fast and slow meteors was approximately constant for all magnitudes.

In the course of these observations several brilliant and interesting fireballs were recorded. Particularly worthy of note is a fireball which appeared on the night of Aug. 27-28, probably between 10.30 and 11.00 p.m. It started from Polaris and burst near the head of Draco, leaving a train which was visible for over 30 seconds. It exhibited a pear-shaped head and was of a brilliant reddish hue. On July 8, at about 10.00 p.m., a meteor which burst into two was observed, the two parts continuing on one behind the other. On Oct. 29-30 one meteor made a distinct curve at the end of its path, another seemed to hesitate several times in the course of its flight, and a third had four maxima of brightness.

This very fine work by M. Mathieu would be greatly increased in value if we had someone else in eastern Quebec making regular meteor observations. However, it is an encouraging sign to find that interest in astronomical matters is gradually increasing in eastern Canada and we may look forward to the time when there will be centres of the Royal Astronomical Society of Canada east of Montreal. I wish to thank M. Mathieu for his very earnest zeal in carrying out the work described above.

P. M. M.

# REVIEW OF PUBLICATIONS

*Our Wonderful Universe*, by C. A. Chant. Revised edition. P. 280, 5½×8 ins. Ryerson Press, Toronto; George G. Harrap, London, England, 1940. Price, $2.00.

This book, first printed in 1928, has been so popular that the English edition was reprinted four times, and the book was also translated into German, Polish, and Czechoslovakian. Now Professor Chant has completed a new greatly enlarged and improved edition.

In general scope *Our Wonderful Universe* is a very simple and elementary description of our present knowledge of the universe, and an exposition of some of the processes by which our knowledge has been obtained. The text is supplemented by over two hundred illustrations. The great number and fine quality of the drawings and photographs have been among the charms of the book in its previous editions; the revised edition is still more noteworthy in this respect.

The first two parts, 136 pages, dealing with the celestial sphere and solar system, remain practically unchanged in this revision. The third section, on the stellar system, has been expanded to 130 pages, almost three times its former size. This part is brought up to date and is now much more in keeping with the greater emphasis that has been placed on researches into the space beyond our sun's own family during the past quarter century. The value of the book is thus greatly increased.

This has always been a satisfactory book for young people and other beginners in the study of astronomy. The amplified edition will serve this purpose much better. As in previous editions, the typography, illustrations and paper are all of pleasing quality.

F. S. H.

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F. S. H.

# NOTES AND QUERIES

**Communications are invited, especially from amateurs. The Editor will try to secure answers to queries.**

## Death of J. N. Tribble

Mr. John Norman Tribble (born June 5, 1879) died on April 8, 1940, in Ottawa, Canada, where some years ago ill health had enforced his superannuation from the Auditor General's Office, an important branch of which he had supervised for many years, having commenced this work in November, 1907. Shortly after graduation in mathematics, physics and astronomy from the University of Toronto, B.A., 1907, Mr. Tribble was engaged in the spectroscopic observation and investigation of binary star systems, notably iota Orionis and theta Aquilae, at the Dominion Observatory, Ottawa.

R.E.DeL.

## A Bright Comet

The last conspicuous naked eye comet was Halley's in 1910 and it had received so many notices in the press that most people were disappointed with it. They expected something more spectacular. Since then there have been a few comets which could be seen without telescopic assistance if you knew where to look for them. At present there is a comet in the sky which is expected to be easily visible in January.

On September 5 Mr. L. E. Cunningham, using the 8-inch Ross telescope of the Oak Ridge station of the Harvard Observatory, took a photograph, which, when examined on September 15, revealed the presence of a faint comet in the northerly part of Cygnus. On further investigation the comet was detected on eleven plates taken between August 25 and September 15. In the early part of January it will be a little east and somewhat south of the bright star Altair. It will be closest to the earth on January 10 (about 50 million miles distant) and for a week from that date it will be quite bright. At this time it will be in Sagittarius, not far from the ecliptic and will be seen for an hour or longer in the west after sunset.

C.A.C.

## Death of Sir Oliver Lodge

Oliver Joseph Lodge was born at Penkull near Stoke-on-Trent on June 12, 1851, and died near Salisbury on August 22, 1940. His father was connected with the pottery trade, which Oliver entered at the age of fourteen. But he soon found out that it was science, not business, that interested him most. Maxwell's great treatise on Electricity was published in 1873, and, as is well known, its author endeavoured to embody in precise mathematical language the results of Faraday's researches. Lodge became the great interpreter of Maxwell's views. In his investigations into the electric spark he demonstrated the existence of electric oscillations and their transmission by wires, and he came very near the discovery of electric waves in free space. That was made by Hertz in his brilliant researches in the years 1885-88, and Lodge enthusiastically led the way in England in experiments in this field.

In 1893 Lodge published a well-illustrated volume entitled "Pioneers of Science". It had its origin in a course of lectures on the history and progress of astronomy. The lives of the great pioneers are described in a vivid and appreciative way.

Lodge was big of body, being six feet four inches tall, and was kindly and approachable in nature. He attended scientific meetings in Canada and also visited the country on other occasions. He had a happy family of six sons and six daughters. In the *London Times Literary Supplement* for August 31 is a brief sketch of Lodge's career which is printed below.

The death of Sir Oliver Lodge removes one of the last of the great Victorian physicists from the scientific stage. Lodge's experimental researches in physics were conducted during the last quarter of the nineteenth century, during which period he was, in succession, on the teaching staff of the universities of London and Liverpool. Of these researches there can be little doubt that those relating to the nature of electric oscillations and waves are the most distinguished, for it is no exaggeration to say that they constitute an essential element in the growth of that remarkable development in physical science which has to-day resulted in broadcasting and television.

Lodge's interest in electric waves was a natural outcome of his study of lightning and lightning conductors. He was at that time (1888) concerned with a question, which as it happens has only been satisfactorily answered within recent years, whether the flow of electricity in a lightning channel con-

tinues in a single direction, or whether there is a vibration of the electricity, to and fro, during the stroke. Lodge succeeded in producing such electrical vibrations in wires artificially, and actually measured the wave-length of the resulting travelling waves. That he came very near to the discovery of electric or radio waves in space, as distinct from electric waves guided by wires, is warranted by the now famous admission of Hertz.

To the development of the technique of using electric waves in space for signalling, Lodge made important contributions. He devised an early form of detector for radio waves and himself coined the word coherer, a term which later received general adoption. But his most important contribution in this field was undeniably the recognition of the importance of what he called syntony, and what we now call tuning, in radio communication. Lodge's active years as an experimental physicist coincided also with the period in which the existence of the ether was under active discussion. In this discussion, prompted by the central problem of detecting the motion of the earth relative to the supposedly all-pervading ether, he took a vigorous and at times stubbornly controversial part.

Sir Oliver Lodge and Sir William Crookes will long be remembered as two men of first-class scientific attainments who devoted much of the residue of their intellectual powers to what we generally speak of as psychical research. Lodge's first interest in the subject was stirred when, in 1889, he was introduced by F. W. H. Myers to the American medium, Mrs. Piper. He was deeply impressed by her powers and became inspired from that time with the desire to find scientific proof for the survival of the personality and the possibility of receiving communications from the spirits of the dead, a line of research that was not incompatible with the orthodox Christianity that was his single religious faith. The Society for Psychical Research, with which his name became so closely associated, provided just the means he desired for pursuing the investigation on unprejudiced lines; but after the death of his son in the last war, he may be said to have forsaken the strictly detached attitude of the purely scientific observer; and his book "Raymond" was published against the recommendation of the Society.

In the Halley Stewart lectures delivered by him in 1926, he is still advocating the continued search for the proof of immortality by scientific methods, but there can be no doubt that he, himself, had "soared above them in an atmosphere of faith". In his autobiography, "Past Years", published nine years ago, he wrote "At an early age I decided that my main business was with the imponderables . . . the things that worked secretly and have to be apprehended mentally". In physics that decision led him to an unshakable allegiance to the theory of an "ether" pervading all space, in psychical research to a profound belief in the possibility of communication with the spirits of the dead.

C. A. C.

# MEETINGS OF THE SOCIETY

## AT VANCOUVER

*March 12, 1940.*—The seventieth meeting of the Vancouver Centre was held in Room 200 of the Science Building of the University of British Columbia. The president of the Centre, Mr. C. A. McDonald, was in the chair, and introduced the speaker of the evening, Dr. Ralph Hull of the Department of Mathematics of the University of British Columbia. Dr. Hull gave an enjoyable and informative address on "Tides", illustrating his lecture by suitable blackboard diagrams and a group of well-chosen lantern slides. The speaker dealt with his very complex subject in a remarkably lucid manner, pointing out, step by step, the various influences at work in producing the tides, and the many perturbing effects that must be taken into account in order to give a theoretical treatment of the subject. The question of our complex local tides was treated at some length and a comparison made with other types of tides found on the earth.

Tidal periodicities were discussed in some detail and a presentation given by the speaker of the equilibrium theory of tides. This typothesis, Dr. Hull pointed out, leaves much unexplained. Many of the discrepancies, however, have been removed by the so-called Dynamical Theory of tides. The speaker noted in closing that although much has been accomplished qualitatively, a great deal of quantitative work remains to be done.

Dr. Hull's excellent treatment of his subject was followed by a lengthy discussion, in which many of the audience joined. The president then presented a hearty vote of thanks to the speaker, after which the meeting adjourned.

*April 9, 1940.*—The seventy-first meeting of the Vancouver Centre was held in the usual place. The president, Mr. C. A. McDonald, introduced the speaker of the evening, Dr. R. M. Petrie, of the Dominion Astrophysical Observatory, Victoria, who presented an exceptionally interesting address on the "Atmospheres of the Planets". The speaker began by stating that the greater part of our knowledge of this subject has been gained only recently, and that these advances have been made possible, firstly, by the progress that has been made in the study of molecular spectra, secondly, by the development of new photographic emulsions sensitive to longer wave-length radiations in the infra-red regions of the spectrum, thirdly, by the use of the largest telescopes of high light-gathering power with the spectrographs employed in planetary spectroscopy.

Dr. Petrie then discussed all available evidence for the existence of the atmospheres on the moon and planets. This knowledge may be grouped into five divisions as follows: (a) Surface appearance such as marks, streaks and

zones, observed through powerful telescopes or in photographs of the planets; (b) Albedo or reflecting power of the surfaces of the planets. Bodies with extensive atmospheres such as Venus, Jupiter and Saturn are good reflectors of light; (c) Twilight and refraction effects which are of importance in indicating the presence of atmospheres, especially in the case of the nearer planets; (d) Spectroscopic studies which give information on the constituent gases in the planetary atmospheres; (e) Calculations of planetary gravitational attractions which enable one to determine the "escape-velocities" of various molecules at the surfaces of different planets, thereby indicating what gases may be retained by a planet at various temperatures.

An application of the above criteria led the speaker to the following conclusions. The moon and Mercury have no atmospheres, while Venus possesses a dense envelope containing more than 10,000 times the quantity of carbon dioxide present in our atmosphere. The constituents of the fairly extensive Martian atmosphere are not well known. Water vapor is undoubtedly present, but the oxygen content is less than one-thousandth of that on earth. The major planets, Jupiter, Saturn, Uranus and Neptune, possess dense atmospheres containing methane, ammonia, and probably large amounts of hydrogen. The meagre evidence available concerning the smaller planet Pluto indicates an atmosphere similar to that of the earth or Mars.

An enthusiastic discussion followed Dr. Petrie's lucid and informative address, after which the President expressed the thanks of the audience to the speaker.

H. D. Smith, *Secretary.*

*April 11, 1939.*—The sixty-second meeting of the Vancouver Centre was held at eight-fifteen p.m. in Room 200 of the Science Building, University of British Columbia, on Tuesday, April 11th, 1939.

Mr. C. E. Bastin, vice-president, opened the meeting and introduced the speaker of the evening, Dr. J. S. Plaskett, retired director of the Dominion Astrophysical Observatory at Victoria and a dean of Canadian astronomers. The address on "The Use of Large Telescopes" was a very timely talk, serving the double purpose of explaining the recent trend toward large telescope construction and surveying some of the results obtained at the Dominion Astrophysical Observatory.

Dr. Plaskett first mentioned a few of the problems, such as visual observations on the solar system, which could be handled satisfactorily with smaller telescopes up to two feet in aperture. Then he directed our attention to the question of the structure and motions of the galactic and extra-galactic systems which may only be solved using the superior light-gathering power of the largest telescopes. One of the earliest researches undertaken with the 72-inch reflector at Victoria was the determination of the radial velocities of O and B type stars. When completed some five years ago, this work added materially to the knowledge of our galaxy. The Swedish astronomer Lindblad had

suggested rotation of our disc-like galaxy, and the Dutch astronomer Oort had estimated that the centre of rotation was situated in Sagittarius at the position of the geometrical centre as calculated by Shapley. The determination by Plaskett and Pearce of the radial velocities of 849 bright stars fully confirmed these theoretical conjectures and added definite reliable data concerning our universe. The rotation of the galaxy about the distant centre in Sagittarius is such that the orbital velocity decreases as we recede from the centre. Yet our sun is carrying the solar system with it at a velocity of 175 miles a second in this gigantic whirl!

Dr. Plaskett mentioned his admiration for the telescope-making firm of Warner & Swasey, with which he had been associated for a long period. Finally he reviewed some of the cosmological problems concerning extra-galactic nebulae and our supposed expanding universe which await the construction of the 200-inch telescope.

Mr. Teasdale expressed the warm thanks of an enthusiastic audience to our guest.

A. M. Crooker, *Secretary.*

*May 9, 1939.*—Minutes of the sixty-third regular meeting of the Vancouver Centre of the Royal Astronomical Society of Canada, held in the University of British Columbia on Tuesday, May 9, 1939.

At about 6.50 p.m., fourteen (members and guests) sat down to dinner in the faculty room of the University Cafeteria. After the meal, at the suggestion of the Vice-President, Mr. C. E. Bastin, who presided, each one present related the circumstances which led to his becoming interested in astronomy.

At 8 p.m., those assembled adjourned to room 200 of the Science building to listen to the following addresses by members of the Centre:

"Sun Dials" by Mr. N. D. B. Phillips.

"The Origin of Lunar Craters" by Mr. H. P. Newton.

Mr. Phillips, after explaining the method of reading and correcting the common type of sun dial, and after showing numerous excellent slides of famous sun dials in different parts of the world, dwelt on the advantages of the type of dial which he had devised in order to eliminate the necessity of applying the correction for the equation of time. By means of a model, and slides, he gave a very clear idea of the structural features and the method of calibrating and reading this type of dial.

There was a general discussion of points raised by the speaker and by questions asked by interested members.

Mr. Newton opened his address by a discussion of the physical conditions existing on the moon, and their relation to the various theories that have been proposed in order to explain the origin of the so-called craters. While the usually considered possible causes were being listed, mention was made of the minute crater-like marks that occur at electrically-welded joints in metal.

## AT HAMILTON

*April 4, 1940.*—The regular monthly meeting of the Royal Astronomical Society of Canada, Hamilton Centre, was held on the above date in the Art Gallery.

This meeting was unique in that it was handled in its entirety by the ladies of the Centre. Mrs. Wm. Findlay, in occupying the chair, thanked the president and executive for the opportunity.

The minutes of the previous meeting were read by Miss Grace Mason, while Mrs. Geo. Campbell was appointed to record the minutes for the "femme-fest".

The curtain raiser was an outline history of astronomy, given by Miss Nellie Corke. This ranged from the early inhabitants of Asia Minor, through Egyptian, Hellenic and Mid-European to modern times.

Mrs. A. E. Johns in introducing the speaker of the evening enumerated the many accomplishments of Dr. Helen Sawyer Hogg, and praised her present line of endeavour, that of observing and recording variable stars.

The speaker took as her subject "Variable Stars and The Amateur's Contribution to Astronomy," which was handled in a masterly way, fortified by Dr. Hogg's own experience in this field. After a number of questions answered in a clear and concise manner, the speaker was moved a vote of thanks by Miss A. S. Turner, which was heartily responded to.

Mrs. J. A. Marsh, who was scheduled to say a few words at the opening of the meeting, was unable to attend.

H. B. Fox, *Secretary.*

## AT WINNNIPEG

*October 9, 1940.*—The regular meeting of the Royal Astronomical Society of Canada, Winnipeg Centre, was held in Rupert's Land Ladies' College. The president, Mr. L. J. Crocker, was in the chair.

The speaker of the evening was Mrs. E. L. Taylor, who is a past president of the local society. Her subject was "The splendour of the Heavens and what our great telescopes reveal."

Mrs. Taylor illustrated her lecture with many fine lantern slides.

From earliest beliefs the growth of astronomical knowledge was traced up to the present day. When Galileo turned his first telescope on the Milky Way in 1610 it revealed a universe which has since expanded to enormous proportions. Compared with to-day the universe, visible three hundred years ago, is as a drop of water compared with the ocean.

As late as 1939, a very interesting photograph, showing a star cluster across a chasm of 200,000 million million miles was taken. It was computed that the light arriving from the cluster took so long to get here that scientists saw the stars as they were in 33000 B.C.

After the interesting lecture a pleasant social hour was spent over a cup of tea and goodies.

Olive A. Armstrong,
*Secretary.*

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